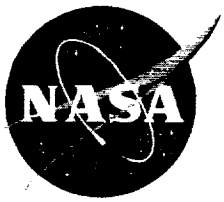
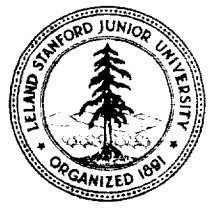
Annual Research Briefs – 1996

Center for Turbulence Research

December 1996



Ames Research Center



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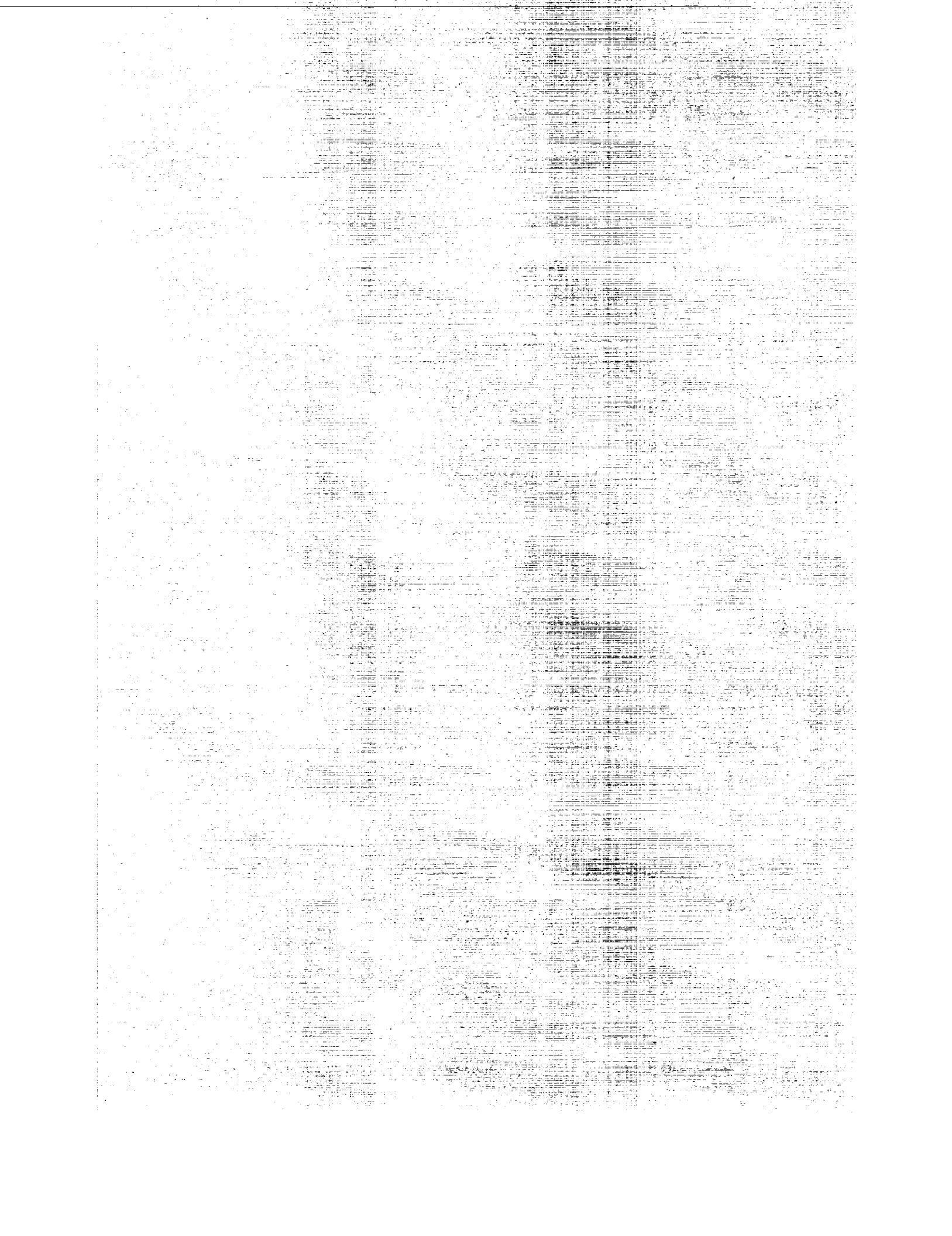

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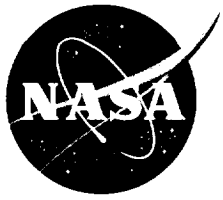

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Preface

This report contains the 1996 annual progress reports of the research fellows and students supported by the Center for Turbulence Research. Last year, CTR hosted twelve resident Postdoctoral Fellows, three Research Associates, four Senior Research Fellows, and supported one doctoral student and ten short term visitors. The major portion of Stanford's doctoral research program in turbulence is sponsored by other support from the United States Office of Naval Research and the Air Force Office of Scientific Research. Many students supported by these programs also conduct their research at the CTR, but their work is not included in this report.

In addition to supporting the work reported in this volume, CTR sponsored its sixth summer program in 1996, its largest ever, with thirty-seven participants. A separate report documenting the findings from the sixth CTR Summer Program was published earlier this year. Both the Annual Research Briefs and Summer Proceedings are available at CTR's site on the world wide web (http://www-fpc.stanford.edu/CTR/welcome.html).

The first group of reports in this volume is concerned with turbulence modeling. This is a very important component of the CTR program, owing to its potential impact on engineering applications. A notable study was the demonstration of the excellent prediction capabilities of the $k - \epsilon - v^2$ model (developed earlier at CTR) for impingement cooling used for high-powered electronic chips. The 1996 CTR Summer Program Report contains several other applications of this model to complex flows. The next group of reports is in turbulent combustion, which included an extension of the large eddy simulation methodology to premixed combustion. LES is making successful inroads into the prediction of turbulent combustion. The third group of reports is in the area of computational acoustics and turbulence physics and control. The fundamental computational acoustics program at CTR is now being directed to applications in complex flows. These calculations are very time consuming, but are expected to provide insight into the mechanisms and control of flow generated noise. The final and the largest group of reports is concerned with large eddy simulation of turbulent flows. Recently, CTR's work in this area has been concentrating on the application of dynamic model-based LES (developed earlier at CTR) to complex flows and the assessment of the effects of numerical errors and boundary conditions on the predictive capabilities of this method. Although LES has been shown to be successful in prediction of complex separated flows, it is still taxing the present computational resources, and more effort is being devoted towards making LES more efficient to use.

The CTR's roster for 1996 is provided in the Appendix. Also listed are the members of the Advisory Committee, which meets annually to review the Center's program, and the Steering Committee, which acts on fellowship applications.

In 1996, a new division called Flow Physics and Computation was formed as a joint activity of the Departments of Mechanical Engineering and Aeronautics and

Astronautics at Stanford. The Division consists of eight faculty members and numerous students who are interested in fluid mechanics and computational methods for a variety of flow prediction and control applications. It is expected that this new critical mass activity and the recent positive developments at NASA Ames will lead to enhancement and strengthening of research in fluid mechanics and turbulence. CTR, of course, will be a direct beneficiary of these developments.

It is always a pleasure to use this opportunity to thank Mrs. Debra Spinks for her unrelenting efforts in the daily management of the Center and her compilation of this report.

Parviz Moin
William C. Reynolds
Nagi N. Mansour